PIPED LIGHT

Light entering at one end of a glass rod will travel along it, following any bends and twists, until it comes out at the far end. The light beams are trapped inside the rod by being internally reflected from the walls throughout its length. The principle is utilized in endoscopic medical photography, instrument dial illumination and in some electric signs. A more common application is the decorative illumination of fountains, by directing light up the jet of water.

The thickness of the rod is immaterial, bundles of thin rods passing as much light as a single thick one. The American Optical Co. has exploited this fact in developing a flexible rope of fine glass fibres which transmits light like a hosepipe.

An image formed at one end of the rope (as on a ground glass screen) is transmitted in minute components along each fibre and reconstructed at the other end virtually unchanged, since the light beams, in effect, travel parallel to each other. To achieve this, the arrangement of fibres at one end must be exactly the same as at the other, however haphazard they may be in between. The image would otherwise be "scrambled". It follows that the image, for instance of a star, may be changed to fit any receiving apparatus, such as the slit in a spectrograph. It also follows that by varying the diameter of the fibres between one end and the other, some degree of enlargement or reduction is possible.

There are limitations to the system. The fibres must not be of less diameter than the wavelength of light, but as this is between 5 and 10 microns it is unlikely to cause serious inconvenience. The tighter the fibres are packed at the ends, the better is the image quality. However, when two fibres come within half a light wavelength of each other, light leaks between the two. This is overcome by insulating each fibre with a thin transparent coating of slightly different refractive index. A difference of only 1·3 per cent is sufficient. Between the ends the fibres can be packed as loosely as desired; in fact, a loose "lay" offers greater flexibility. Experiments with more flexible plastic fibres, however, have proved that optical glass is by far the best medium for light transmission.

The applications of fibre optical systems are too numerous for detailed elaboration. There are obvious uses for still, cine and television cameras with "elephant-trunk" lenses: in high-speed aircraft for instance, mounting a large camera in a "bulge" in the fuselage skin may cause considerable drag which would be reduced by mounting only the lens in a small "blister" and piping away the image to a camera hidden inside the fuselage. The possibility of incorporating glass fibres in television and radar tube faces is being investigated. The image would be led to a printing room and recorded merely by contact printing from the exit face of the rope. The scrambling facility can be used to "encode" and "decode" a picture for military or other purposes. The possibilities are endless and cover an enormous field.

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Gene:
I ran across this article a day or two after talking with you. Thought you'd be interested.

Milt
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